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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/560,555	04/28/2000	David L. Stephenson	15-4-910.00	3306

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EXAMINER
GROSS, KENNETH A

ART UNIT	PAPER NUMBER
2122	

DATE MAILED: 12/23/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Offic Action Summary	**Application No.** 09/560,555	**Applicant(s)** STEPHENSON ET AL.	
	Examiner Kenneth A Gross	**Art Unit** 2122	

-- The MAILING DATE of this communication appears on the cover sheet with the corresp ndence address --

Period for R ply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11/18/02* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. This action is in response to the amendment filed on 11/18/02.

Specification

2. Regarding the amendment to the specification, the corrected text has been entered and the objection is withdrawn.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claim 1 rejected under 35 U.S.C. 102(b) as being anticipated by Buzbee (U.S. Patent No. 5,815,720).

Buzbee teaches the following: (1) accessing the first intermediate representation of source code with instrumented instructions. "Annotations are placed in the first object code. The translator utilizes the annotations within the first object code to determine the particular profiling code to be placed within the second object code and thus to determine the profile information which will be generated." (Column 2, lines 20-25); (2) Annotating intermediate code with feedback data as shown in Figure 5, element 42; (4) Optimizing intermediate code using feedback data. "Profile information 36 is used during a second compile to produce an optimized application 38. (Column 3, lines 55-56, figure 6); (5) Repeating the updates to the propagation data and the optimization based on this feedback data to further optimize code. The "process my be repeated to generate additional profile information about the optimized object code to further optimize object code for the application." (Column 2, lines 16-18).

In regard to the amendment to Claim 1, Buzbee teaches updating the annotations at compile time to obtain new profile information (Column 5, lines 50-52).

In regard to the amended Claim 14, the following 35 U.S.C. 102(b) rejection is added:

5. Claim 14 is rejected under 35 U.S.C. 102(b) as being anticipated by Buzbee (U.S. Patent No. 5,815,720).

Buzbee teaches the following: (1) accessing the first intermediate representation of source code with instrumented instructions. "Annotations are placed in the first object code. The translator utilizes the annotations within the first object code to determine the particular profiling code to be placed within the second object code and thus to determine the profile information which will be generated." (Column 2, lines 20-25); (2) Annotating intermediate code with feedback data as shown in Figure 5, element 42; (3) Updating feedback data using a propagation scheme at multiple points during compilation. Buzbee teaches, "The annotations are adjusted on each compilation to obtain additional profile information" (Column 5, lines 50-52). Since annotations implies more than one annotation, each annotation is updated at multiple points during compile time; (4) Optimizing intermediate code using feedback data. "Profile information 36 is used during a second compile to produce an optimized application 38. (Column 3, lines 55-56, figure 6); (5) Repeating the updates to the propagation data and the optimization based on this feedback data to further optimize code. The "process my be repeated to generate additional profile information about the optimized object code to further optimize object code for the application." (Column 2, lines 16-18).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720), as applied to Claim 1 above, in view of Chaitin (U.S. Patent No. 4,656,582).

Buzbee does not specify if dead code elimination, dead store elimination, branch elimination, or code transformation optimizations are preformed. However, the Chaitin reference teaches a method of optimizing compiled code using dead code elimination. (Column 9, line 40) Chaitin calls dead code elimination a "standard technique." Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the optimization method outlined by Buzbee wherein the method uses dead code elimination, since it is a standard and beneficial technique for optimization.

8. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720), as applied to Claim 1 above, in view of Robert Morgan, "Building an Optimizing Compiler" (hereinafter Morgan).

Buzbee does not mention that the second source code (or intermediate representation) should be represented a tree corresponding to procedures within the source code. However, Morgan teaches in Chapter 4, Section 1 (page 94) that "Optimizing compilers use a range of different data structures to represent procedures being compiled…the procedure may be represented as a tree…it is natural to represent the procedure as a tree." See abstract syntax trees in Section 4.1 for representing procedures. Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the optimization method outlined by Buzbee wherein the intermediate representation of the source code would be a tree structure as taught by Morgan, since a tree representation allows for easier access to parsed data.

9. Claims 4, 5, 8, 12, 13, 17, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720) in view of Robert Morgan, "Building an Optimizing Compiler" (hereinafter Morgan) and further in view of Larus (U.S. Patent Number 6,327,699).

With respect to claim 4, as applied to Claim 3 above, the combination of Buzbee and Morgan does not teach the conversion from a tree to a control flow graph and the annotation of frequency values to said control graph as described by applicant in Claim 4. However, the Larus reference does teach the conversion of a program into a control flow graph, which profiles the entire path of a program. Larus describes a method that instruments a program with code and then executes the program in order to trace the entire path of the program. Furthermore, Larus teaches that the control flow graph would collect metrics as it profiles the program path, one such metric being the frequency of the execution of a program path. (Claims 1, 6, 7 of Larus)

Since it is beneficial to represent source code as a tree, it would have been apparent to convert a tree into a control flow diagram, deriving the benefits from the tree representation. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to construct an optimizing compiler taught by Buzbee wherein the intermediate representation of the source code would be a tree structure as taught by Morgan, since a tree representation allows for easier access to parse data. It would then be obvious to convert this tree into a control flow graph as taught by Larus and then run a plurality of sample executions on the code, collecting frequency information as taught by Larus, since this is a more beneficial method for collecting frequency information.

With respect to Claim 5, Buzbee teaches that his translator generates profile information by "associating counters with the branches (arc counting)" or with "code representing each line." (Column 7, lines 1-3) These counter values, being precise measurements, can be classified as EXACT values. Therefore, it is obvious to one with ordinary skill in the art at the time of the invention to use a source code optimizing compiler described by Buzbee with a tree representation of the intermediate code. It is further obvious to construct a flow graph from this tree, giving counter values to the arcs of said flow graph, and labeling these counter values as EXACT, since they represent the exact number of times certain portions of code have been executed.

With respect to Claim 8, it was taught above that it is beneficial to convert a tree representation of code into a flow chart diagram for easier collection of frequency data. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a computer program product as described by Buzbee to perform optimizations, with a product means of constructing a flow graph from a tree representation of code and collecting frequency information from said flow graph, in order to implement the method of construction and frequency collection already shown to be beneficial.

10. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720).

Buzbee teaches the following: A computer system with (1) means for computer access to intermediate representation of source code with instrumented instructions. "A computer system comprising: a translator which translates first object code of a high-level language program to a second object code (Column 10, lines 1-4)...a compiler which compiles source code to generate first object code (Column 10, lines 15-18)...a computing system as in claim 12 wherein the compiler places annotations in the first object code (Column 10, lines 26-27)...the translator utilizes the annotations ...to determine content of profiling code." (Column 10, lines 28-31); (2) means for annotating intermediate code with feedback data. "Means for adding profiling code to the second object code." (Column 10, lines 5-6); (4) means for optimizing intermediate code using feedback data. (Column 10, lines 22-25).

Buzbee, however, does not teach a means for repeating the updates to the propagation data and the optimization based on this feedback data to further optimize the code. Yet Buzbee does teach the *method* of repeated executions of the optimizing compiler, citing the benefits of repeated optimizations (Column 2, lines 16-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to compile the source code multiple times using the computer system means described by Buzbee, since this would be the same as implementing a program code means for re-executing the compiler optimization function.

In regard to the amendment to Claim 6, Buzbee teaches updating the annotations at compile time to obtain new profile information (Column 5, lines 50-52), which is obviously represented by program code in a computer system.

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720) in view of Robert Morgan, "Building an Optimizing Compiler" (hereinafter Morgan).

As shown in the paragraph above, the Buzbee reference anticipates the applicant's claim of a computer program product for optimizing source code in Claim 6. It was also shown in paragraph number 6 that it is natural to represent code in a tree format. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a computer program product as described by Buzbee to perform optimizations where the intermediate representation of code is stored in tree format, shown to be a natural representation by Morgan, in order to derive the benefits of a tree representation.

11. In regard to the amended Claims 9-13, 15-19, and 20, the following 35 U.S.C. 103(a) rejections are added:

12. Claims 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720) in view of Larus et al. (U.S. Patent Number 6,327,699).

Buzbee teaches the following: (1) accessing the first intermediate representation of source code with instrumented instructions. "Annotations are placed in the first object code. The translator utilizes the annotations within the first object code to determine the particular profiling code to be placed within the second object code and thus to determine the profile information which will be generated." (Column 2, lines 20-25); (2) Annotating intermediate code with data as shown in Figure 5, element 42; (3) Updating data using a propagation scheme. This is shown in Figure 5, elements 44-45, where a translator generates profile information based on annotations; (4) Optimizing intermediate code using data. "Profile information 36 is used during a second compile to produce an optimized application 38. (Column 3, lines 55-56, figure 6); (5) Repeating the updates to the propagation data and the optimization based on this feedback data to further optimize code. The "process my be repeated to generate additional profile information about the optimized object code to further optimize object code for the application." (Column 2, lines 16-18). Buzbee does not teach that the data mentioned in steps 2, 3, and 4 above is global and local frequency data. Larus, however, does teach instrumenting a program in order to gather frequency data of branch execution (Column 11, lines 25-32 and Column 12, lines 13-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to apply the method of optimization, as taught by Buzbee, where the data collected for optimization is frequency data, as taught by Larus, since this would allow for better information regarding program execution.

13. Claims 10 and 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720), as applied to Claim 1 above, in view of Chaitin (U.S. Patent No. 4,656,582).

Claims 10 and 15 correspond directly with Claim 2, respectively, and are rejected for the same reasons as Claims 3, respectively.

14. Claims 11 and 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720), as applied to Claim 1 above, in view of Robert Morgan, "Building an Optimizing Compiler" (hereinafter Morgan).

Claims 11 and 16 correspond directly with Claim 3, respectively, and are rejected for the same reasons as Claims 3, respectively.

15. Claims 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee (U.S. Patent Number 5,815,720) in view of Dean et al (U.S. Patent Number 6,070,009).

In regard to Claim 20, Buzbee teaches the following: (1) accessing the first intermediate representation of source code with instrumented instructions. "Annotations are placed in the first object code. The translator utilizes the annotations within the first object code to determine the particular profiling code to be placed within the second object code and thus to determine the profile information which will be generated." (Column 2, lines 20-25); (2) Annotating intermediate code with data as shown in Figure 5, element 42; (3) Updating data using a propagation scheme. This is shown in Figure 5, elements 44-45, where a translator generates profile information based on annotations; (4) Optimizing intermediate code using data. "Profile information 36 is used during a second compile to produce an optimized application 38. (Column 3, lines 55-56, figure 6); (5) Repeating the updates to the propagation data and the optimization based on this feedback data to further optimize code. The "process my be repeated to generate additional profile information about the optimized object code to further optimize object code for the application." (Column 2, lines 16-18). Buzbee does not teach that the data is estimated frequency data, however Dean does teach path profiling, where execution frequencies of selected paths are estimated. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to apply the method of optimization, as taught by Buzbee, where the data collected for optimization is frequency data, as taught by Larus, since this would allow for better information regarding program execution.

In regard to Claim 19, Dean teaches estimating path frequencies based on path profiling. Since an estimation can be seen as a guess, it is obvious that "GUESS" would be one of the labels for an edge of the program's control flow graph.

Response to Arguments

In regard to applicant's comments on the 35 U.S.C. 102(b) rejection of Claim 1, the examiner redirects the applicant's attention to Figure 5 of Buzbee. While the translator is indeed run after the compilation of code, it is shown by Buzbee that annotations are added and adjusted during the compile phase (item 42). The application in item 43 is an optimized application after the *recompilation* of the source code based on profile data.

Conclusion

16. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kenneth A Gross whose telephone number is (703) 305-0542. The examiner can normally be reached on Mon-Fri 7:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory A Morse can be reached on (703) 308-4789. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 746-7239 for regular communications and (703) 746-7240 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

KAG
December 9, 2002

Greg A Morse

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